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HEWLETT PACKARD COMPANY
P O BOX 272400, 3404 E. HARMONY ROAD
INTELLECTUAL PROPERTY ADMINISTRATION
FORT COLLINS, CO 80527-2400

EXAMINER	
CHEN, QING	
ART UNIT	**PAPER NUMBER**
2191	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/17/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/676,557	LOWELL ET AL.	
	Examiner	Art Unit	
	Qing Chen	2191	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-72* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-72* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *01 October 2003* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. This is the initial Office action based on the application filed on October 1, 2003.

2. **Claims 1-72** are pending.

Drawings

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description:

- Reference number 810 in Figure 8.

Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application.

Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not

accepted by the Examiner, the Applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

4. The disclosure is objected to because of the following informalities:

- The specification contains the following typographical errors:
  - The application numbers and the filing dates for the U.S. patent applications incorporated by reference are missing on page 9, paragraph [0038]; page 10, paragraph [0040]; page 12, paragraph [0047]; and page 48, paragraph [0048].
  - The attorney docket numbers should be deleted on page 9, paragraph [0038]; page 10, paragraph [0040]; page 12, paragraph [0047]; and page 48, paragraph [0048].
  - "U.S. Serial No." should read -- U.S. Patent Application Serial No. -- on page 9, paragraph [0038]; page 10, paragraph [0040]; page 12, paragraph [0047]; and page 48, paragraph [0048].
- The specification lacks definition on what the acronym IOCTL stands for.

Appropriate correction is required.

5. The attempt to incorporate subject matter into this application by reference to applications on page 12, paragraph [0047] and page 13, paragraph [0048] is ineffective because the root words "incorporate" and/or "reference" have been omitted as required by 37 CFR 1.57(b)(1) and the reference documents are not clearly identified as required by 37 CFR 1.57(b)(2).

6. The use of trademarks, such as WINDOWS and LINUX, has been noted in this application. Trademarks should be capitalized wherever they appear (capitalize each letter OR accompany each trademark with an appropriate designation symbol, *e.g.*, ™ or ®) and be accompanied by the generic terminology (use trademarks as adjectives modifying a descriptive noun, *e.g.*, "the JAVA programming language").

Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner, which might adversely affect their validity as trademarks.

Claim Objections

7. **Claims 2-4, 6-11, 15, 18-30, 32-35, 37, 49-55, 57-60, and 63** are objected to because of the following informalities:

- **Claims 2-4, 52, 53, 58-60, and 63** recite the limitation "the hardware." Applicant is advised to change this limitation to read "the computer hardware" for the purpose of providing it with proper explicit antecedent basis.
- **Claims 54 and 55** depend on Claim 53 and, therefore, suffer the same deficiency as Claim 53.
- **Claims 6, 32, and 53** recite the limitation "the operating system handlers." Applicant is advised to change this limitation to read "the operating system interrupt handlers" for the purpose of providing it with proper explicit antecedent basis.

- **Claims 7-11** depend on Claim 6 and, therefore, suffer the same deficiency as Claim 6.
- **Claims 33-35** depend on Claim 32 and, therefore, suffer the same deficiency as Claim 32.
- **Claims 54 and 55** depend on Claim 53 and, therefore, suffer the same deficiency as Claim 53.
- **Claims 9 and 23** contain a typographical error: a period (.) should be added after the limitation body.
- **Claims 15, 37, and 57** contain a typographical error: "physical to machine memory" should read -- physical-to-machine memory --. Applicant is advised to make the correction in order to keep the grammatical style consistent throughout the claims.
- **Claim 18** recites the limitation "the device." Applicant is advised to change this limitation to read "the I/O device" for the purpose of providing it with proper explicit antecedent basis.
- **Claim 19** recites the limitation "the hardware." Applicant is advised to change this limitation to read "the virtualized computer hardware" for the purpose of providing it with proper explicit antecedent basis.
- **Claims 20-30** depend on Claim 19 and, therefore, suffer the same deficiency as Claim 19.
- **Claims 20 and 21** recite the limitation "the computer hardware." Applicant is advised to change this limitation to read "the virtualized computer hardware" for the purpose of providing it with proper explicit antecedent basis.

- **Claims 22-24** depend on Claim 21 and, therefore, suffer the same deficiency as Claim 21.

- **Claim 21** recites the limitation "the virtual machine monitor handlers." Applicant is advised to change this limitation to read "the virtual machine monitor interrupt handlers" for the purpose of providing it with proper explicit antecedent basis.

- **Claims 22-24** depend on Claim 21 and, therefore, suffer the same deficiency as Claim 21.

- **Claim 24** recites the limitation "the memory." Applicant is advised to change this limitation to read "the physical memory" for the purpose of providing it with proper explicit antecedent basis.

- **Claim 49** recites the limitation "the computer hardware." Applicant is advised to change this limitation to read "the hardware" for the purpose of providing it with proper explicit antecedent basis.

- **Claims 50 and 51** depend on Claim 49 and, therefore, suffer the same deficiency as Claim 49.

Appropriate correction is required.

Double Patenting

8. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

9. **Claims 41 and 62** are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claims 44 and 56 of copending Application No. 10/677,159. Although the conflicting claims are not identical, they are not patentably distinct from each other because Claims 41 and 62 of the instant application define an obvious variation of the invention claimed in copending Application No. 10/677,159.

Claims 41 and 62 of the instant application are obvious over copending application Claims 44 and 56 in that Claims 44 and 56 of the copending application contain all the limitations of Claims 41 and 62 of the instant application. Claims 41 and 62 of the instant

application are, therefore, not patently distinct from the copending application claims and as such are unpatentable for obviousness-type double patenting.

Claims 41 and 62 of the instant application as shown in the tables below contain every element of Claims 44 and 56 of the copending application and as such are obvious over Claims 44 and 56 of the copending application.

Co-Pending Application 10/677,159	Instant Application 10/676,557
44. A computer comprising:	41. A computer comprising:
hardware including memory; and	hardware, the hardware including memory, the memory encoded with
a virtual machine monitor for virtualizing the memory and devirtualizing the memory at runtime.	means for virtualizing the hardware, and means for devirtualizing the hardware at runtime.

Co-Pending Application 10/677,159	Instant Application 10/676,557
56. An article for a computer including hardware, the hardware including computer memory, the article comprising:	62. An article for use with an operating system on computer hardware, the article comprising:
memory encoded with software for devirtualizing the computer memory at runtime.	software for devirtualizing at least some virtualized hardware at runtime.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Claim Rejections - 35 USC § 112

10. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

11. **Claims 8, 17, 34, 38, 39, 52-60, and 62-72** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 8 and 34 recite the limitation "the privilege level." There is insufficient antecedent basis for this limitation in the claims. In the interest of compact prosecution, the Examiner subsequently interprets this limitation as reading "privilege level" for the purpose of further examination.

Claims 17, 38, 39, and 59 recite the limitation "the dual-mode driver." There is insufficient antecedent basis for this limitation in the claims. In the interest of compact prosecution, the Examiner subsequently interprets this limitation as reading "the dual-mode drivers" for the purpose of further examination.

Claims 52 and 62 recite the limitation "at least some." The term "some" is a relative term, which renders the claims indefinite. The term "some" is not defined by the claims nor does the specification provide a standard for ascertaining the requisite degree and one of ordinary skill in the art would not be able to reasonably determine the scope of the invention. In the interest of

compact prosecution, the Examiner subsequently does not give any patentable weight to this limitation for the purpose of further examination.

Claims 53-60 depend on Claim 52 and, therefore, suffer the same deficiency as Claim 52.

Claims 63-72 depend on Claim 62 and, therefore, suffer the same deficiency as Claim 62.

Claim 53 recites the limitation "the virtual machine monitor." There is insufficient antecedent basis for this limitation in the claim. In the interest of compact prosecution, the Examiner subsequently interprets this limitation as reading "a virtual machine monitor" for the purpose of further examination.

Claims 54 and 55 depend on Claim 53 and, therefore, suffer the same deficiency as Claim 53.

Claims 56, 64, 67, 68, and 71 recite the limitation "the memory." There is insufficient antecedent basis for this limitation in the claims. In the interest of compact prosecution, the Examiner subsequently interprets this limitation as reading "a memory" for the purpose of further examination.

Claim 69 depends on Claim 67 and, therefore, suffers the same deficiency as Claim 67.

Claim 68 recites the limitation "a part of the memory." The term "part" is a relative term, which renders the claim indefinite. The term "part" is not defined by the claim nor does the specification provide a standard for ascertaining the requisite degree and one of ordinary skill in the art would not be able to reasonably determine the scope of the invention. In the interest of compact prosecution, the Examiner subsequently does not give any patentable weight to this limitation for the purpose of further examination.

Claim Rejections - 35 USC § 101

12. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

13. **Claims 1-72** are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

The result of **Claims 1-18 and 31-40** is directed to the act of "interposing," which does not appear to be a tangible result so as to constitute a practical application of the idea. The act of "interposing" is merely a thought or an abstract idea and does not appear to produce a tangible result even if the step of "interposing" does occur, since the result of that interposition is not conveyed in the real world. The result is an interposition, which is neither used in a disclosed practical application nor made available for use in a disclosed practical application. It also does

not appear that the usefulness of the interposition can be realized from the claimed steps to support a disclosed specific, substantial, and credible utility so as to produce a useful result.

Therefore, the claims do not meet the statutory requirement of 35 U.S.C. § 101, since the claims are not directed to a practical application of the § 101 judicial exception producing a result tied to the physical world.

The result of **Claims 19-30, 41-51, and 62-72** is directed to the act of "devirtualizing," which does not appear to be a tangible result so as to constitute a practical application of the idea. The act of "devirtualizing" is merely a thought or an abstract idea and does not appear to produce a tangible result even if the step of "devirtualizing" does occur, since the result of that devirtualization is not conveyed in the real world.

Claims 19-30, 41-51, and 62-72 are rejected for the same reasons set forth in the rejections of Claim 1-18 and 31-40.

The result of **Claims 52-60** is directed to the act of "virtualizing," which does not appear to be a tangible result so as to constitute a practical application of the idea. The act of "virtualizing" is merely a thought or an abstract idea and does not appear to produce a tangible result even if the step of "virtualizing" does occur, since the result of that virtualization is not conveyed in the real world.

Claims 52-60 are rejected for the same reasons set forth in the rejections of Claim 1-18 and 31-40.

Claims 52-60 and 62-72 are directed to articles comprising software. The recited components of the articles appear to lack the necessary physical components (hardware) to constitute a machine or manufacture under § 101. Therefore, the claims are directed to articles of functional descriptive material *per se*, and hence non-statutory.

The claims constitute computer programs representing computer listings *per se*. Such descriptions or expressions of the programs are not physical "things." They are neither computer components nor statutory processes, as they are not "acts" being performed. Such claimed computer programs do not define any structural and functional interrelationships between the computer program and other claimed elements of a computer, which permit the computer program's functionality to be realized. In contrast, a claimed computer-readable medium encoded with a computer program is a computer element, which defines structural and functional interrelationships between the computer program and the rest of the computer, that permits the computer program's functionality to be realized, and is thus statutory. See *Lowry*, 32 F.3d at 1583-84, 32 USPQ2d at 1035.

The result of **Claim 61** is directed to the act of "interfacing," which does not appear to be a tangible result so as to constitute a practical application of the idea. The act of "interfacing" is merely a thought or an abstract idea and does not appear to produce a tangible result even if the step of "interfacing" does occur, since the result of that interface is not conveyed in the real world.

Claim 61 is rejected for the same reasons set forth in the rejections of Claim 1-18 and 31-40.

Claim Rejections - 35 USC § 102

14. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

15. **Claims 1, 4-21, 23, 25-43, 45, 49-64, 66, and 70-72** are rejected under 35 U.S.C. 102(b) as being anticipated by **Bugnion et al. (US 6,075,938)**.

As per **Claim 1**, Bugnion et al. disclose:

- interposing the virtual machine monitor between the computer hardware and the operating system at runtime *(see Figure 1; Column 9: 24-26, "Disco runs multiple independent virtual machines simultaneously on the same hardware by virtualizing all the resources of the machine.").*

As per **Claim 4**, the rejection of **Claim 1** is incorporated; and Bugnion et al. further disclose:

- devirtualizing the computer hardware after the virtual machine monitor has been interposed *(see Column 11: 17-19, "Disco will deschedule the virtual CPU until the mode is cleared or an interrupt is posted.").*

As per **Claim 5**, the rejection of **Claim 1** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware includes a CPU; and wherein the virtual machine monitor is interposed on the CPU *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ...").*

As per **Claim 6**, the rejection of **Claim 5** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware further includes memory, and the virtual machine monitor and the operating system each include CPU interrupt handlers; and wherein interposing the virtual machine monitor on the CPU includes causing privileged instructions to trap to the virtual machine monitor, and redirecting interrupts from the operating system interrupt handlers to the corresponding virtual machine monitor interrupt handlers *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ..."; Column 11: 31-34, "When a trap such as page fault, system call, or bus error occurs, the processor traps to the monitor that emulates the effect of the trap on the currently scheduled virtual processor. This is done by updating the privileged registers of the virtual processor and jumping to the virtual machine's trap vector.").*

As per **Claim 7**, the rejection of **Claim 6** is incorporated; and Bugnion et al. further disclose:

- wherein the privileged instructions are caused to trap to the virtual machine monitor by causing the operating system to run at a reduced privilege level; and wherein interposing the virtual machine monitor on the CPU further includes returning control to the operating system at the reduced privilege level *(see Column 11: 25-28, "Supervisor mode allows the operating system to use a protected portion of the address space (the supervisor segment) but does not give access to privileged instructions or physical memory.").*

As per **Claim 8**, the rejection of **Claim 6** is incorporated; and Bugnion et al. further disclose:

- wherein the privileged instructions are caused to trap to the virtual machine monitor by using a kernel module of the operating system to reduce privilege level of the operating system *(see Column 11: 37-41, "Disco maintains all the privileged registers in the VCPU structure. Privileged instructions that change the state of privileged registers are emulated by the monitor.").*

As per **Claim 9**, the rejection of **Claim 6** is incorporated; and Bugnion et al. further disclose:

- wherein interposing the virtual machine monitor on the CPU further includes disabling physical memory access by the operating system *(see Column 3: 39-41, "By running the OS in supervisor mode, it disables direct access to I/O resources and physical memory, without having to virtualize them.").*

As per **Claim 10**, the rejection of **Claim 6** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware includes memory; and wherein interposing the virtual machine monitor on the CPU further includes loading the virtual machine monitor into the memory *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ...").*

As per **Claim 11**, the rejection of **Claim 10** is incorporated; and Bugnion et al. further disclose:

- wherein a kernel module of the operating system is used to allocate memory within the operating system, pin the allocated memory, and load the virtual machine monitor into the pinned memory *(see Column 10: 37-40, "... the small code segment of Disco, currently 72KB, is replicated into all the memories of FLASH machine so that all instruction cache misses can be satisfied from the local node.").*

As per **Claim 12**, the rejection of **Claim 5** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware includes memory; and wherein the virtual machine monitor is also interposed on the memory *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ...").*

As per **Claim 13**, the rejection of **Claim 12** is incorporated; and Bugnion et al. further disclose:

- wherein interposing the virtual machine monitor on the memory includes partitioning the memory, and giving the virtual machine monitor access to at least one of the partitions *(see Column 2: 42-44, "VM/370 maps virtual disks to distinct volumes (partitions) ...").*

As per **Claim 14**, the rejection of **Claim 12** is incorporated; and Bugnion et al. further disclose:

- wherein interposing the virtual machine monitor on the memory includes using a kernel module of the operating system to allocate a block of the memory, pin the block to prevent the operating system from using the block, and allocate the pinned block to the virtual machine monitor *(see Column 10: 37-40, "... the small code segment of Disco, currently 72KB, is replicated into all the memories of FLASH machine so that all instruction cache misses can be satisfied from the local node.").*

As per **Claim 15**, the rejection of **Claim 12** is incorporated; and Bugnion et al. further disclose:

- wherein interposing the virtual machine monitor on the memory includes constructing an Identity mapping of physical-to-machine memory; and commencing using the virtual machine monitor at runtime to manage memory translation *(see Column 12: 6-15, "To virtualize physical memory, Disco adds a level of address translation and maintains physical-to-machine address*

mappings." and "Disco performs this physical-to-machine translation using the software-reloaded translation-lookaside buffer (TLB) of the MIPS processor.").

As per **Claim 16**, the rejection of **Claim 5** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware includes an I/O device, and wherein the virtual machine monitor is also interposed on the I/O device *(see Column 9: 63-67 through Column 10: 1-2, "... requiring Disco to virtualize each I/O device."; Column 14: 32-34, "To virtualize access to I/O devices, Disco intercepts all device accesses from the virtual machine and forwards them to the physical devices.").*

As per **Claim 17**, the rejection of **Claim 16** is incorporated; and Bugnion et al. further disclose:

- wherein the operating system includes dual-mode drivers that perform direct hardware control in a first mode and communicate with device drivers of the virtual machine monitor in a second mode; and wherein interposing the virtual machine monitor on the I/O device includes setting the dual-mode drivers to the second mode; and redirecting I/O interrupts from interrupt handlers in the operating system to interrupt handlers in the virtual machine monitor *(see Column 11: 48-51, "Hardware interrupts are handled directly by the VMM through its own device drivers. The VMM posts an interrupt to the virtual machine when the operation that it has requested completes."; Column 14: 38-54, "We found it was much cleaner to simply*

add special device drivers into the operating system." and "Disco's device drivers then interact directly with the physical device."; Column 17: 14-28).

As per **Claim 18**, the rejection of **Claim 16** is incorporated; and Bugnion et al. further disclose:

- wherein interposing the virtual machine monitor on the I/O device includes commencing I/O emulation of the I/O device at runtime *(see Column 9: 63-67 through Column 10: 1-2, "Disco must intercept all communication to and from I/O devices to translate or emulate the operation.").*

As per **Claim 19**, Bugnion et al. disclose:

- devirtualizing the virtualized computer hardware at runtime *(see Column 11: 17-19, "Disco will deschedule the virtual CPU until the mode is cleared or an interrupt is posted.").*

As per **Claim 20**, the rejection of **Claim 19** is incorporated; and Bugnion et al. further disclose:

- wherein the virtualized computer hardware includes a CPU; and wherein the CPU is devirtualized at runtime *(see Column 11: 17-19, "Disco will deschedule the virtual CPU until the mode is cleared or an interrupt is posted.").*

As per **Claim 21**, the rejection of **Claim 20** is incorporated; and Bugnion et al. further disclose:

- wherein the virtualized computer hardware further includes physical memory, and the virtual machine monitor and the operating system each include CPU interrupt handlers; and wherein devirtualizing the CPU includes redirecting interrupts from the virtual machine monitor interrupt handlers to the corresponding operating system interrupt handlers *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ..."; Column 11: 31-34, "When a trap such as page fault, system call, or bus error occurs, the processor traps to the monitor that emulates the effect of the trap on the currently scheduled virtual processor. This is done by updating the privileged registers of the virtual processor and jumping to the virtual machine's trap vector.")*.

As per **Claim 23**, the rejection of **Claim 21** is incorporated; and Bugnion et al. further disclose:

- wherein devirtualizing the CPU further includes enabling physical memory access by the operating system *(see Column 13: 16-19, "... the memory management part of Disco must also deal with the allocation of real memory to virtual machines.")*.

As per **Claim 25**, the rejection of **Claim 19** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware includes memory; and wherein the memory is devirtualized at runtime *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ...")*.

As per **Claim 26**, the rejection of **Claim 25** is incorporated; and Bugnion et al. further disclose:

- wherein memory was allocated from the operating system to the virtual machine monitor during virtualization of the memory; and wherein devirtualizing the memory includes returning the allocated memory to the operating system *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ...").*

As per **Claim 27**, the rejection of **Claim 25** is incorporated; and Bugnion et al. further disclose:

- wherein devirtualizing the memory includes remapping physical memory so a physical-to-machine mapping becomes an Identity mapping; and using the operating system to manage address translation with respect to the devirtualized memory *(see Column 12: 6-15, "To virtualize physical memory, Disco adds a level of address translation and maintains physical-to-machine address mappings." and "Disco performs this physical-to-machine translation using the software-reloaded translation-lookaside buffer (TLB) of the MIPS processor.").*

As per **Claim 28**, the rejection of **Claim 19** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware includes an I/O device, and wherein the I/O device is devirtualized at runtime *(see Column 9: 63-67 through Column 10: 1-13, "... requiring Disco to virtualize each I/O device." and "... these modifications can be made ... non-persistent so that they disappear with each reboot.").*

As per **Claim 29**, the rejection of **Claim 28** is incorporated; and Bugnion et al. further disclose:

- wherein the operating system includes dual-mode drivers that perform direct hardware control in a first mode and communicate with device drivers of the virtual machine monitor in a second mode; and wherein devirtualizing the I/O device includes setting the dual-mode drivers to the first mode; and redirecting I/O interrupts from handlers in the virtual machine monitor to handlers in the operating system *(see Column 11: 48-51, "Hardware interrupts are handled directly by the VMM through its own device drivers. The VMM posts an interrupt to the virtual machine when the operation that it has requested completes."; Column 14: 38-54, "We found it was much cleaner to simply add special device drivers into the operating system." and "Disco's device drivers then interact directly with the physical device."; Column 17: 14-28).*

As per **Claim 30**, the rejection of **Claim 28** is incorporated; and Bugnion et al. further disclose:

- wherein devirtualizing the I/O device includes ceasing emulation of the I/O device at runtime *(see Column 10: 1-13, "... these modifications can be made ... non-persistent so that they disappear with each reboot.").*

As per **Claim 31**, Bugnion et al. disclose:

- hardware, the hardware including memory, the memory encoded with an operating system, a virtual machine monitor, and means for interposing the virtual machine monitor on the hardware at runtime *(see Figure 1; Column 9: 24-26, "Disco runs multiple independent virtual machines simultaneously on the same hardware by virtualizing all the resources of the machine.").*

As per **Claim 32**, the rejection of **Claim 31** is incorporated; and Bugnion et al. further disclose:

- wherein the hardware further includes a CPU, and the virtual machine monitor and the operating system each include CPU interrupt handlers; and wherein the interposing means causes privileged instructions to trap to the virtual machine monitor, and redirects interrupts and traps from the operating system interrupt handlers to the corresponding virtual machine monitor interrupt handlers, whereby the virtual machine monitor is interposed on the CPU at runtime *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ..."; Column 11: 31-34, "When a trap such as page fault, system call, or bus error occurs, the processor traps to the monitor that emulates the effect of the trap on the currently scheduled virtual processor. This is done by updating the privileged registers of the virtual processor and jumping to the virtual machine's trap vector.").*

As per **Claim 33**, the rejection of **Claim 32** is incorporated; and Bugnion et al. further disclose:

- wherein the interposing means causes privileged instructions to trap to the virtual machine monitor by causing the operating system to run at a reduced privilege level; and wherein the interposing means reduces privilege level of the operating system after redirecting the interrupts, and returns control to the operating system at the reduced privilege level *(see Column 11: 25-28, "Supervisor mode allows the operating system to use a protected portion of the address space (the supervisor segment) but does not give access to privileged instructions or physical memory.").*

As per **Claim 34**, the rejection of **Claim 32** is incorporated; and Bugnion et al. further disclose:

- wherein the interposing means includes a kernel module of the operating system for reducing privilege level of the operating system, whereby the privileged instructions trap to the virtual machine monitor *(see Column 11: 37-41, "Disco maintains all the privileged registers in the VCPU structure. Privileged instructions that change the state of privileged registers are emulated by the monitor.").*

As per **Claim 35**, the rejection of **Claim 32** is incorporated; and Bugnion et al. further disclose:

- wherein the interposing means disables physical memory access by the operating system *(see Column 3: 39-41, "By running the OS in supervisor mode, it disables direct access to I/O resources and physical memory, without having to virtualize them.").*

As per **Claim 36**, the rejection of **Claim 31** is incorporated; and Bugnion et al. further disclose:

- wherein the interposing means includes a kernel module of the operating system for allocating a block of the memory, pinning the block to prevent the operating system from using the block, and allocating the pinned block to the virtual machine monitor, whereby the virtual machine monitor is interposed on the memory at runtime *(see Column 10: 37-40, "... the small code segment of Disco, currently 72KB, is replicated into all the memories of FLASH machine so that all instruction cache misses can be satisfied from the local node.").*

As per **Claim 37**, the rejection of **Claim 31** is incorporated; and Bugnion et al. further disclose:

- wherein the interposing means constructs an Identity mapping of physical-to-machine memory; and commences using the virtual machine monitor at runtime to manage memory translation, whereby the virtual machine monitor is interposed on the memory at runtime *(see Column 12: 6-15, "To virtualize physical memory, Disco adds a level of address translation and maintains physical-to-machine address mappings." and "Disco performs this physical-to-machine translation using the software-reloaded translation-lookaside buffer (TLB) of the MIPS processor.").*

As per **Claim 38**, the rejection of **Claim 31** is incorporated; and Bugnion et al. further disclose:

- wherein the hardware further includes an I/O device; and wherein the interposing means includes operating system dual-mode drivers that perform direct hardware control in a first mode and communicate with device drivers of the virtual machine monitor in a second mode; and wherein the interposing means sets the dual-mode drivers to the second mode; and redirects I/O interrupts from interrupt handlers in the operating system to interrupt handlers in the virtual machine monitor, whereby the virtual machine monitor is interposed on the I/O device at runtime *(see Column 11: 48-51, "Hardware interrupts are handled directly by the VMM through its own device drivers. The VMM posts an interrupt to the virtual machine when the operation that it has requested completes."; Column 14: 38-54, "We found it was much cleaner to simply add special device drivers into the operating system." and "Disco's device drivers then interact directly with the physical device."; Column 17: 14-28).*

As per **Claim 39**, the rejection of **Claim 31** is incorporated; and Bugnion et al. further disclose:

- wherein the hardware further includes an I/O device; and wherein the operating system includes dual-mode drivers that perform direct hardware control in a first mode and communicate with device drivers of the virtual machine monitor in a second mode; and wherein the interposing means sets the dual-mode drivers to the second mode; and redirects I/O interrupts from interrupt handlers in the operating system to interrupt handlers in the virtual machine monitor, whereby the virtual machine monitor is interposed on the I/O device *(see Column 11: 48-51, "Hardware interrupts are handled directly by the VMM through its own device drivers. The VMM posts an interrupt to the virtual machine when the operation that it has requested*

completes."; Column 14: 38-54, "We found it was much cleaner to simply add special device drivers into the operating system." and "Disco's device drivers then interact directly with the physical device."; Column 17: 14-28).

As per **Claim 40**, the rejection of **Claim 31** is incorporated; and Bugnion et al. further disclose:

- wherein the hardware further includes an I/O device; and wherein the interposing means commences I/O emulation of the I/O device at runtime, whereby the virtual machine monitor is interposed on the I/O device at runtime *(see Column 9: 63-67 through Column 10: 1-2, "Disco must intercept all communication to and from I/O devices to translate or emulate the operation.").*

As per **Claim 41**, Bugnion et al. disclose:

- hardware, the hardware including memory, the memory encoded with means for virtualizing the hardware, and means for devirtualizing the hardware at runtime *(see Figure 1; Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ..."; Column 9: 24-26, "Disco runs multiple independent virtual machines simultaneously on the same hardware by virtualizing all the resources of the machine."; Column 11: 17-19, "Disco will deschedule the virtual CPU until the mode is cleared or an interrupt is posted.").*

As per **Claim 42**, the rejection of **Claim 41** is incorporated; and Bugnion et al. further disclose:

- wherein the hardware further includes a CPU; and wherein the devirtualizing means devirtualizes the CPU at runtime *(see Column 11: 17-19, "Disco will deschedule the virtual CPU until the mode is cleared or an interrupt is posted.").*

As per **Claim 43**, the rejection of **Claim 42** is incorporated; and Bugnion et al. further disclose:

- wherein the memory is further encoded with an operating system including interrupt handlers; wherein the virtualizing means includes interrupt handlers; and wherein the devirtualizing means redirects interrupts from the interrupt handlers of the virtualizing means to the corresponding interrupt handlers of the operating system *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ..."; Column 11: 31-34, "When a trap such as page fault, system call, or bus error occurs, the processor traps to the monitor that emulates the effect of the trap on the currently scheduled virtual processor. This is done by updating the privileged registers of the virtual processor and jumping to the virtual machine's trap vector.").*

As per **Claim 45**, the rejection of **Claim 43** is incorporated; and Bugnion et al. further disclose:

- wherein the devirtualizing means enables physical memory access by the operating system *(see Column 13: 16-19, "... the memory management part of Disco must also deal with the allocation of real memory to virtual machines.").*

As per **Claim 49**, the rejection of **Claim 41** is incorporated; and Bugnion et al. further disclose:

- wherein the hardware includes an I/O device, wherein the virtualizing means virtualizes the I/O device; and wherein the devirtualizing means devirtualizes the I/O device at runtime *(see Column 9: 63-67 through Column 10: 1-13, "... requiring Disco to virtualize each I/O device." and "... these modifications can be made ... non-persistent so that they disappear with each reboot.").*

As per **Claim 50**, the rejection of **Claim 49** is incorporated; and Bugnion et al. further disclose:

- wherein the memory is further encoded with an operating system including dual-mode drivers that perform direct hardware control in a first mode and communicate with device drivers of the virtualizing means in a second mode; and wherein the devirtualizing means sets the dual-mode drivers to the first mode; and redirects I/O interrupts from handlers in the virtualizing means to handlers in the operating system *(see Column 11: 48-51, "Hardware interrupts are handled directly by the VMM through its own device drivers. The VMM posts an interrupt to the virtual machine when the operation that it has requested completes."; Column 14: 38-54, "We*

found it was much cleaner to simply add special device drivers into the operating system." and "Disco's device drivers then interact directly with the physical device."; Column 17: 14-28).

As per **Claim 51**, the rejection of **Claim 49** is incorporated; and Bugnion et al. further disclose:

- wherein the devirtualizing means ceases emulation of the I/O device at runtime *(see Column 10: 1-13, "... these modifications can be made ... non-persistent so that they disappear with each reboot.").*

As per **Claim 52**, Bugnion et al. disclose:

- software for virtualizing at least some of the computer hardware at runtime *(see Figure 1; Column 9: 24-26, "Disco runs multiple independent virtual machines simultaneously on the same hardware by virtualizing all the resources of the machine.").*

As per **Claim 53**, the rejection of **Claim 52** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware further includes a CPU, and a virtual machine monitor and the operating system each include CPU interrupt handlers; and wherein the software causes privileged instructions to trap to the virtual machine monitor, and causes interrupts and traps to be redirected from the operating system interrupt handlers to the corresponding virtual machine monitor interrupt handlers *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ..."; Column 11: 31-34, "When a trap*

such as page fault, system call, or bus error occurs, the processor traps to the monitor that emulates the effect of the trap on the currently scheduled virtual processor. This is done by updating the privileged registers of the virtual processor and jumping to the virtual machine's trap vector.").

As per **Claim 54**, the rejection of **Claim 53** is incorporated; and Bugnion et al. further disclose:

- wherein the software causes the privileged instructions to trap by reducing privilege level of the operating system, and wherein the software causes control to be returned to the operating system at the reduced privilege level *(see Column 11: 25-28, "Supervisor mode allows the operating system to use a protected portion of the address space (the supervisor segment) but does not give access to privileged instructions or physical memory.").*

As per **Claim 55**, the rejection of **Claim 53** is incorporated; and Bugnion et al. further disclose:

- wherein the software causes physical memory access by the operating system to be disabled *(see Column 3: 39-41, "By running the OS in supervisor mode, it disables direct access to I/O resources and physical memory, without having to virtualize them.").*

As per **Claim 56**, the rejection of **Claim 52** is incorporated; and Bugnion et al. further disclose:

- wherein the software includes a virtual machine monitor for causing a kernel module of the operating system to allocate a block of a memory, pin the block to prevent the operating system from using the block, and allocate the pinned block to the virtual machine monitor *(see Column 10: 37-40, "... the small code segment of Disco, currently 72KB, is replicated into all the memories of FLASH machine so that all instruction cache misses can be satisfied from the local node.").*

As per **Claim 57**, the rejection of **Claim 52** is incorporated; and Bugnion et al. further disclose:

- wherein the software includes a virtual machine monitor that causes an Identity mapping of physical-to-machine memory to be constructed; and that manages memory translation at runtime *(see Column 12: 6-15, "To virtualize physical memory, Disco adds a level of address translation and maintains physical-to-machine address mappings." and "Disco performs this physical-to-machine translation using the software-reloaded translation-lookaside buffer (TLB) of the MIPS processor.").*

As per **Claim 58**, the rejection of **Claim 52** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware further includes an I/O device; and wherein the software includes an operating system dual-mode driver that performs direct hardware control in a first mode and communicates with a corresponding device driver of a virtual machine monitor in a second mode; and wherein the dual-mode driver is set to the second mode during runtime

interposition; and wherein I/O interrupts are redirected from interrupt handlers in the operating system to interrupt handlers in the virtual machine monitor *(see Column 11: 48-51, "Hardware interrupts are handled directly by the VMM through its own device drivers. The VMM posts an interrupt to the virtual machine when the operation that it has requested completes."; Column 14: 38-54, "We found it was much cleaner to simply add special device drivers into the operating system." and "Disco's device drivers then interact directly with the physical device."; Column 17: 14-28).*

As per **Claim 59**, the rejection of **Claim 52** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware further includes an I/O device; and wherein the operating system includes dual-mode drivers that perform direct hardware control in a first mode and communicate with device drivers of the virtual machine monitor in a second mode; and wherein the dual-mode drivers are set to the second mode during interposition; and wherein I/O interrupts are redirected from interrupt handlers in the operating system to interrupt handlers in the virtual machine monitor *(see Column 11: 48-51, "Hardware interrupts are handled directly by the VMM through its own device drivers. The VMM posts an interrupt to the virtual machine when the operation that it has requested completes."; Column 14: 38-54, "We found it was much cleaner to simply add special device drivers into the operating system." and "Disco's device drivers then interact directly with the physical device."; Column 17: 14-28).*

As per **Claim 60**, the rejection of **Claim 52** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware further includes an I/O device; and wherein the software causes I/O emulation of the I/O device to commence at runtime *(see Column 9: 63-67 through Column 10: 1-2, "Disco must intercept all communication to and from I/O devices to translate or emulate the operation.").*

As per **Claim 61**, Bugnion et al. disclose:

- computer memory encoded with an I/O driver having first and second modes of operation, the I/O driver operable in the first mode to interface directly between the operating system and the I/O device, the I/O driver operable in the second mode to interface between the operating system and a corresponding I/O driver of the virtual machine monitor *(see Column 11: 48-51, "Hardware interrupts are handled directly by the VMM through its own device drivers. The VMM posts an interrupt to the virtual machine when the operation that it has requested completes."; Column 14: 38-54, "We found it was much cleaner to simply add special device drivers into the operating system." and "Disco's device drivers then interact directly with the physical device."; Column 17: 14-28).*

As per **Claim 62**, Bugnion et al. disclose:

- software for devirtualizing at least some virtualized hardware at runtime *(see Column 11: 17-19, "Disco will deschedule the virtual CPU until the mode is cleared or an interrupt is posted.").*

As per **Claim 63**, the rejection of **Claim 62** is incorporated; and Bugnion et al. further disclose:

- wherein the computer hardware further includes a CPU; and wherein the software causes the CPU to be devirtualized at runtime *(see Column 11: 17-19, "Disco will deschedule the virtual CPU until the mode is cleared or an interrupt is posted.").*

As per **Claim 64**, the rejection of **Claim 63** is incorporated; and Bugnion et al. further disclose:

- wherein a memory is further encoded with an operating system including first interrupt handlers; wherein the software includes second interrupt handlers; and wherein the software causes interrupts to be redirected from the second interrupt handlers to the corresponding first interrupt handlers *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ..."; Column 11: 31-34, "When a trap such as page fault, system call, or bus error occurs, the processor traps to the monitor that emulates the effect of the trap on the currently scheduled virtual processor. This is done by updating the privileged registers of the virtual processor and jumping to the virtual machine's trap vector.").*

As per **Claim 66**, the rejection of **Claim 64** is incorporated; and Bugnion et al. further disclose:

- wherein the software causes physical memory access by the operating system to be enabled *(see Column 13: 16-19, "... the memory management part of Disco must also deal with the allocation of real memory to virtual machines.").*

As per **Claim 70**, the rejection of **Claim 62** is incorporated; and Bugnion et al. further disclose:

- wherein the virtualized hardware includes an I/O device; and wherein the software causes the I/O device to be devirtualized at runtime *(see Column 9: 63-67 through Column 10: 1-13, "... requiring Disco to virtualize each I/O device." and "... these modifications can be made ... non-persistent so that they disappear with each reboot.").*

As per **Claim 71**, the rejection of **Claim 70** is incorporated; and Bugnion et al. further disclose:

- wherein a memory is further encoded with an operating system including dual-mode drivers that perform direct hardware control in a first mode and communicate with virtual device drivers in a second mode; and wherein the software causes the dual-mode drivers to be set to the first mode *(see Column 11: 48-51, "Hardware interrupts are handled directly by the VMM through its own device drivers. The VMM posts an interrupt to the virtual machine when the operation that it has requested completes."; Column 14: 38-54, "We found it was much cleaner to simply add special device drivers into the operating system." and "Disco's device drivers then interact directly with the physical device."; Column 17: 14-28).*

As per **Claim 72**, the rejection of **Claim 70** is incorporated; and Bugnion et al. further disclose:

- wherein the software causes emulation of the I/O device to cease at runtime *(see Column 10: 1-13, "... these modifications can be made ... non-persistent so that they disappear with each reboot.")*.

Claim Rejections - 35 USC § 103

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

17. **Claims 2, 3, 24, 46-48, and 67-69** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Bugnion et al. (US 6,075,938)**.

As per **Claim 2**, the rejection of **Claim 1** is incorporated; however, Bugnion et al. do not disclose:

- booting the operating system on the computer hardware before interposing the virtual machine monitor at runtime.

Official Notice is taken that it is old and well known within the computing art to follow a boot sequence for loading an operating system on a computer. A computer system undergoes a bootstrapping process to start the operating system when the computer system is turned on.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include booting the operating system on the computer hardware before interposing the virtual machine monitor at runtime. The modification would be obvious because one of ordinary skill in the art would be motivated to run the operating system.

As per **Claim 3**, the rejection of **Claim 1** is incorporated; and Bugnion et al. further disclose:

- devirtualizing the computer hardware before interposing the virtual machine monitor at runtime *(see Figure 1; Column 9: 24-26, "Disco runs multiple independent virtual machines simultaneously on the same hardware by virtualizing all the resources of the machine.").*

However, Bugnion et al. do not disclose:

- booting the virtual machine monitor on the computer hardware and booting the operating system on the virtual machine monitor.

Official Notice is taken that it is old and well known within the computing art to follow a boot sequence for loading an operating system on a computer. A computer system undergoes a bootstrapping process to start the operating system when the computer system is turned on. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include booting the virtual machine monitor on the computer hardware and booting the operating system on the virtual machine monitor. The modification would be obvious because one of ordinary skill in the art would be motivated to run the operating system.

As per **Claim 24**, the rejection of **Claim 21** is incorporated; however, Bugnion et al. do not disclose:

- wherein devirtualizing the CPU further includes unloading the virtual machine monitor from the physical memory.

Official Notice is taken that it is old and well known within the computing art to release program data not in active use in a computer memory. Primary storage, such as RAM, is typically very fast and program data is constantly being swapped in and out for processing by the CPU. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include wherein devirtualizing the CPU further includes unloading the virtual machine monitor from the physical memory. The modification would be obvious because one of ordinary skill in the art would be motivated to free up memory space.

As per **Claim 46**, the rejection of **Claim 41** is incorporated; however, Bugnion et al. do not disclose:

- wherein the devirtualizing means devirtualizes the memory at runtime.

Official Notice is taken that it is old and well known within the computing art to "devirtualize" memory at runtime. Once the virtual machine monitor stops running, all hardware components of the computer system are in effect "devirtualized." Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include wherein the devirtualizing means devirtualizes the memory at runtime. The modification would be obvious because one of ordinary skill in the art would be motivated to regain control of hardware components.

As per **Claim 47**, the rejection of **Claim 46** is incorporated; and Bugnion et al. further disclose:

- wherein the virtualizing means allocates memory from an operating system to the virtualizing means; and wherein the devirtualizing means returns the allocated memory to the operating system *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ...").*

As per **Claim 48**, the rejection of **Claim 46** is incorporated; and Bugnion et al. further disclose:

- wherein devirtualizing means remaps physical memory so a physical-to-machine mapping becomes an Identity mapping; and uses an operating system to manage address translation with respect to the devirtualized memory *(see Column 12: 6-15, "To virtualize physical memory, Disco adds a level of address translation and maintains physical-to-machine address mappings." and "Disco performs this physical-to-machine translation using the software-reloaded translation-lookaside buffer (TLB) of the MIPS processor.").*

As per **Claim 67**, the rejection of **Claim 62** is incorporated; however, Bugnion et al. do not disclose:

- wherein the software causes a memory to be devirtualized at runtime.

Official Notice is taken that it is old and well known within the computing art to "devirtualize" memory at runtime. Once the virtual machine monitor stops running, all hardware

components of the computer system are in effect "devirtualized." Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include wherein the software causes a memory to be devirtualized at runtime. The modification would be obvious because one of ordinary skill in the art would be motivated to regain control of hardware components.

As per **Claim 68**, the rejection of **Claim 67** is incorporated; and Bugnion et al. further disclose:

- wherein if a part of a memory was allocated from an operating system to a virtual machine monitor prior to the runtime devirtualization, the software causes the allocated memory to be returned to the operating system as part of the runtime devirtualization *(see Column 8: 62-65, "The virtual machine monitor schedules the virtual resources (processor and memory) ...").*

As per **Claim 69**, the rejection of **Claim 67** is incorporated; and Bugnion et al. further disclose:

- wherein the software causes physical memory to be remapped so a physical-to-machine mapping becomes an Identity mapping; and wherein the software allows an operating system to manage address translation with respect to the devirtualized memory *(see Column 12: 6-15, "To virtualize physical memory, Disco adds a level of address translation and maintains physical-to-machine address mappings." and "Disco performs this physical-to-machine translation using the software-reloaded translation-lookaside buffer (TLB) of the MIPS processor.").*

18. **Claims 22, 44, and 65** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Bugnion et al. (US 6,075,938)** in view of **Bugnion et al. (US 6,496,847) (hereinafter Bugnion02 et al.)**.

As per **Claim 22**, the rejection of **Claim 21** is incorporated; however, Bugnion et al. do not disclose:

- wherein devirtualizing the CPU further includes restoring privilege level of the operating system.

Bugnion02 et al. disclose:

- wherein devirtualizing the CPU further includes restoring privilege level of the operating system *(see Column 13: 62-67, "... the HOS 340 is allowed, according to the invention, to manage resources such as the memory and devices, and to retain most of its normal functions and privileges, such as CPU scheduling.")*.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teaching of Bugnion02 et al. into the teaching of Bugnion et al. to include wherein devirtualizing the CPU further includes restoring privilege level of the operating system. The modification would be obvious because one of ordinary skill in the art would be motivated to resume normal operations of the operating system.

As per **Claim 44**, the rejection of **Claim 43** is incorporated; however, Bugnion et al. do not disclose:

- wherein the devirtualizing means restores privilege level of the operating system.

Bugnion02 et al. disclose:

- wherein the devirtualizing means restores privilege level of the operating system *(see Column 13: 62-67, "... the HOS 340 is allowed, according to the invention, to manage resources such as the memory and devices, and to retain most of its normal functions and privileges, such as CPU scheduling.").*

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teaching of Bugnion02 et al. into the teaching of Bugnion et al. to include wherein the devirtualizing means restores privilege level of the operating system. The modification would be obvious because one of ordinary skill in the art would be motivated to resume normal operations of the operating system.

As per **Claim 65**, the rejection of **Claim 64** is incorporated; however, Bugnion et al. do not disclose:

- wherein the software causes privilege level of the operating system to be restored.

Bugnion02 et al. disclose:

- wherein the software causes privilege level of the operating system to be restored *(see Column 13: 62-67, "... the HOS 340 is allowed, according to the invention, to manage resources such as the memory and devices, and to retain most of its normal functions and privileges, such as CPU scheduling.").*

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teaching of Bugnion02 et al. into the teaching of Bugnion

et al. to include wherein the software causes privilege level of the operating system to be restored. The modification would be obvious because one of ordinary skill in the art would be motivated to resume normal operations of the operating system.

Conclusion

19. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Qing Chen whose telephone number is 571-270-1071. The Examiner can normally be reached on Monday through Thursday from 7:30 AM to 4:00 PM. The Examiner can also be reached on alternate Fridays.

If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, Wei Zhen, can be reached on 571-272-3708. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the TC 2100 Group receptionist whose telephone number is 571-272-2100.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR

system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

QC / ac
April 5, 2007

WEI ZHEN
SUPERVISORY PATENT EXAMI